

DPM 2610

HAZARDOUS MATERIALS DATA SHEET
(PLEASE COMPLETE APPLICABLE SECTION)

1. PRODUCT NAME, NUMBER, SYNONYM: 6244 Etchant Compound
2. MANUFACTURER'S NAME: American Better Chemicals
3. MANUFACTURER'S ADDRESS: 425 Isis Avenue Inglewood, Calif. 90301
4. PROCEDURE IN CASE OF BREAKAGE OR LEAKAGE: Sweep-up powder & water rinse area of spillage
5. TRANSPORTATION AND STORAGE REQUIREMENTS: Transport and store in steel containers. Carboard containers with plastic liners may be used for short term storage and transport.
6. FIRST AID TREATMENT:
- A. SKIN CONTACT: Immediately flush skin with plenty of water
- B. EYE CONTACT: Flush with plenty of water for about 10 minutes and get medical attention.
- C. INHALATION: Obtain medical attention if extensive amount of powder is inhaled.
- D. ANTIDOTE IN CASE OF SWALLOWING: Get medical attention.
7. PHYSIOLOGICAL PROPERTIES:
- A. ACUTE ORAL TOXICITY: Causes severe burns
- B. LOCAL EFFECTS UPON EYES: Causes severe burns
- C. LOCAL EFFECTS UPON SKIN: Causes severe burns
- D. ESTIMATE OF ACUTE HAZARD BY INHALATION (VOLATILE MATERIALS): Not applicable - material non-volatile
- E. WARNING PROPERTIES (ODOR, IRRITATION TO EYES, NOSE OR THROAT): Extremely damaging to skin on contact
- F. ESTIMATED THRESHOLD LIMIT VALUE (IF NOT ON CURRENT LIST BY AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS): Not established - equivalent to caustic soda
8. CHEMICAL AND PHYSICAL PROPERTIES:
- A. SPECIFIC GRAVITY (WATER = 1) not applicable
- B. VAPOR DENSITY (AIR = 1) none
- C. VAPOR PRESSURE mm Hg AT 25°C. not applicable
- D. pH approx. 14
- E. CORROSIVE ACTION ON COMMON MATERIALS SUCH AS: ALUMINUM, MAGNESIUM, PLEXIGLAS, RUBBER, LACQUERS, ENAMELS, FABRICS:
- Aluminum - corrosive effect Magnesium - no effect plexiglas - no effect
Rubber - no effect Lacquers & enamels lifting Fabrics - slow deterioration

F. DOES THE MATERIAL DECOMPOSE WHEN EXPOSED TO AIR? WATER? HEAT? STRONG OXIDIZERS? no

G. FOR MIXTURES GIVE THE PERCENTAGE COMPOSITION OF INGREDIENTS:

COMPOUND	PERCENT
<u>caustic soda</u>	<u>over 85%</u>
<u>sodium gluconate</u>	<u>less than 10%</u>
<u>sodium sulfide</u>	<u>less than 5%</u>
<u>sulfur</u>	<u>less than 3%</u>

NOTE: GENERALIZATIONS SUCH AS PETROLEUM HYDROCARBONS, ALCOHOL, KETONES, CHLORINATED HYDROCARBONS, ETC., ARE NOT ADEQUATE FOR TOXICOLOGICAL EVALUATION. PROPER CHEMICAL NAMES MUST BE KNOWN.

H. DOES THE MATERIAL GENERATE HEAT THROUGH POLYMERIZATION OR CONDENSATION? no

9. PRECAUTIONS FOR NORMAL CONDITIONS OF USE: When making solutions, add slowly to surface of solution to avoid violent spattering. When handling wear goggles and face shield and rubber gloves

10. RECOMMENDED PROTECTIVE EQUIPMENT: rubber gloves, goggles and face shield

11. A. FLASHPOINT °F; CLOSED CUP none OPEN CUP none; IF F.P. CHANGES DURING EVAPORATION GIVE DATA: none

B. EXPLOSIVE LIMITS (% VOL. AIR): none LOWER _____; UPPER _____

C. SUSCEPTIBILITY TO SPONTANEOUS HEATINGS: YES _____; NO X

D. FIRE POINT °F none; AUTO IGNITION TEMPERATURE °F none

E. VAPOR DENSITY none

F. WHAT PRODUCTS MIGHT BE FORMED IN THE EVENT OF FIRE OR ABNORMAL TEMPERATURES? sulfur dioxide, hydrogen sulfide

G. SUITABLE EXTINGUISHING AGENTS: self extinguishing

12. INFORMATION FURNISHED BY:

TITLE: Chemist, Charles Vinton

COMPANY: American Better Chemicals

ADDRESS: 425 Isis Avenue, Inglewood, Calif. 90301

DATE: 12-17-71

NOTE: INFORMATION IN REGARD TO A MATERIAL'S COMPOSITION WILL BE USED FOR THE PURPOSE OF COMPLYING WITH LOCAL, STATE AND FEDERAL ORDINANCES, LAWS AND CODES, AND REQUIREMENTS OF GOVERNMENTAL AGENCIES.

THE COMPLETED FORM SHOULD BE RETURNED TO PURCHASING, DOUGLAS AIRCRAFT DIVISION, LONG BEACH, CALIF. 90801.

HAZARDOUS MATERIALS DATA SHEET
(PLEASE COMPLETE APPLICABLE SECTIONS.)

DPM 2610

1. PRODUCT NAME, NUMBER, SYNONYM: Turcoform Etchant 9H
2. MANUFACTURER'S NAME: Turco Products, Inc.
3. MANUFACTURER'S ADDRESS: 24600 So. Main St., Wilmington, Calif. 90745
4. PROCEDURE IN CASE OF BREAKAGE OR LEAKAGE: Flush to sewer with water.
5. TRANSPORTATION AND STORAGE REQUIREMENTS: Transport and store in closed container at temperatures up to 110°F.
6. FIRST AID TREATMENT:
- A. SKIN CONTACT: Wash with soap and water
- B. EYE CONTACT: Flush with copious amounts of water. Obtain medical attention.
- C. INHALATION: Remove to fresh air.
- D. ANTIDOTE IN CASE OF SWALLOWING: Do not induce vomiting. Give water, egg whites, or 2 oz. olive oil.
7. PHYSIOLOGICAL PROPERTIES:
- A. ACUTE ORAL TOXICITY: Severe
- B. LOCAL EFFECTS UPON EYES: Severe caustic burns
- C. LOCAL EFFECTS UPON SKIN: Severe caustic burns
- D. ESTIMATE OF ACUTE HAZARD BY INHALATION (VOLATILE MATERIALS): Moderate to severe
- E. WARNING PROPERTIES (ODOR, IRRITATION TO EYES, NOSE OR THROAT): Irritation of nose, throat and eyes.
- F. ESTIMATED THRESHOLD LIMIT VALUE (IF NOT ON CURRENT LIST BY AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS): 2 Mg/M³
8. CHEMICAL AND PHYSICAL PROPERTIES:
- A. SPECIFIC GRAVITY (WATER = 1): NA
- B. VAPOR DENSITY (AIR = 1): more than 1
- C. VAPOR PRESSURE mm Hg AT 25°C: Less than 10 mm
- D. pH: 13+
- E. CORROSIVE ACTION ON COMMON MATERIALS SUCH AS: ALUMINUM, MAGNESIUM, PLEXIGLAS, RUBBER, LACQUERS, ENAMELS, FABRICS: Corrosive to aluminum and paint.

F. DOES THE MATERIAL DECOMPOSE WHEN EXPOSED TO AIR? WATER? HEAT? STRONG OXIDIZERS? Avoid strong oxidizers and acids.

G. FOR MIXTURES GIVE THE PERCENTAGE COMPOSITION OF INGREDIENTS:

COMPOUND	PERCENT
<u>Sodium hydroxide</u>	<u>Greater than 90</u>
<u>Sodium sulfide and sulfur</u>	<u>Less than 10</u>
<u> </u>	<u> </u>
<u> </u>	<u> </u>
<u> </u>	<u> </u>

NOTE: GENERALIZATIONS SUCH AS PETROLEUM HYDROCARBONS, ALCOHOL, KETONES, CHLORINATED HYDROCARBONS, ETC., ARE NOT ADEQUATE FOR TOXICOLOGICAL EVALUATION. PROPER CHEMICAL NAMES MUST BE KNOWN.

H. DOES THE MATERIAL GENERATE HEAT THROUGH POLYMERIZATION OR CONDENSATION? No

9. PRECAUTIONS FOR NORMAL CONDITIONS OF USE: Avoid contact with skin and clothing.
Avoid breathing dust with handling dry product.

10. RECOMMENDED PROTECTIVE EQUIPMENT: Dust mask when handling dry product. Face shield, rubber gloves and aprons.

11. A. FLASHPOINT °F: CLOSED CUP NA; OPEN CUP ; IF F.P. CHANGES DURING EVAPORATION GIVE DATA:

B. EXPLOSIVE LIMITS (% VOL. AIR): LOWER Unknown; UPPER Unknown

C. SUSCEPTIBILITY TO SPONTANEOUS HEATINGS: YES ; NO x

D. FIRE POINT °F Unknown; AUTO IGNITION TEMPERATURE °F Unknown

E. VAPOR DENSITY Greater than air

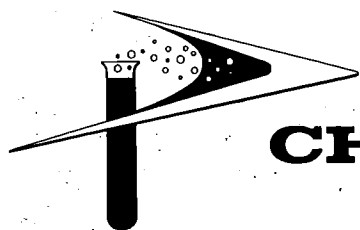
F. WHAT PRODUCTS MIGHT BE FORMED IN THE EVENT OF FIRE OR ABNORMAL TEMPERATURES? Oxides of sulfur

G. SUITABLE EXTINGUISHING AGENTS: Carbon dioxide

12. INFORMATION FURNISHED BY: A. E. Zaelke
TITLE: Chief Technical Service Engineer
COMPANY: Turco Products, Inc.
ADDRESS: 24600 So. Main St., Wilmington, Calif. 90745
12/16/71
DATE:

NOTE: INFORMATION IN REGARD TO A MATERIAL'S COMPOSITION WILL BE USED FOR THE PURPOSE OF COMPLYING WITH LOCAL, STATE AND FEDERAL ORDINANCES, LAWS AND CODES, AND REQUIREMENTS OF GOVERNMENTAL AGENCIES.

THE COMPLETED FORM SHOULD BE RETURNED TO PURCHASING, DOUGLAS AIRCRAFT DIVISION, LONG BEACH, CALIF. 90801.


CHEM-MILL®

AND COATINGS

DIVISION OF TURCO PRODUCTS, INC.

24600 South Main Street • Wilmington, California

TURCOFORM® ETCHANT 9H

Address replies to

Wilmington, Calif. 90744

Cable: Turcola

2/15/71

INTRODUCTION Turcoform Etchant 9H is a specially compounded, dust-free, etchant material for use on the majority of aluminum alloys. When used as recommended, Turcoform Etchant 9H will produce smoothly etched surfaces free from pits or other evidence of irregular etching action. To obtain optimum results on clad alloys, annealed alloys and some 6061, TFE 11 or 13B should be used.

Parts produced with Turcoform Etchant 9H will have maximum fatigue life and optimum physical properties. Because of the many tests which have demonstrated the above qualities, Turcoform Etchant 9H is the only commercially available aluminum etchant accepted by agencies of the United States Department of Defense. The unique characteristics of Turcoform Etchant 9H are consistent, predictable etch rate with close tolerance and uniform metal removal without the formation of undesirable scale.

PHYSICAL PROPERTIES

Appearance yellow flakes
 Composition modified Sodium Hydroxide
 Heat of reaction, per lb. dissolved aluminum 7000 Btu
 One lb. of aluminum dissolved evolves 20 ft.³ of hydrogen

HAZARDOUS PROPERTIES (SODIUM HYDROXIDE) Warning: Causes severe burns to skin and eyes. Avoid contact with skin, eyes and clothing. Do not take internally. When handling, wear goggles or face shield and gloves. In case of contact, immediately flush skin with plenty of water; for eyes, flush with plenty of water for at least 15 minutes and obtain medical attention. When charging a tank, add etchant material slowly to water and stir well.

INITIAL CHARGE

Basis: 100 gallons; N ₁ = 12, N ₂ = 4	
Turcoform Etchant 9H	96 pounds
Turcoform Alketch Inhibitor	60 pounds
Water	to volume
Total charge	100 gallons

Nothing contained herein shall be construed as a recommendation to use any product in conflict with existing patents covering any material or its use. The information and recommendations of Turco concerning this product are based upon our laboratory tests and field use experience and to the best of our knowledge and belief are true and accurate. Since conditions of actual use are beyond our control, any recommendations or suggestions are made without warranty, express or implied. Manufacturer's and Seller's sole obligation shall be to replace that portion of the product shown to be defective. Neither shall be liable for any loss, damage or injury, direct or consequential, arising out of the use of this product.

Fill the etch tank with water to approximately two-thirds of the normal operating level. With continuous, vigorous agitation, slowly add the required amount of Turcoform Etchant 9H. Continue agitation and add water until the operating level has been reached. For optimum line definition and etch factor uniformity, Turcoform Alketch Inhibitor (sodium aluminate) should be added to the freshly prepared etchant solution at the rate of 0.15 pounds per gallon.

REJUVENATING CHARGES See CHEMICAL CONTROL. Always add Turcoform Etchant 9H to the etchant solution slowly and mix thoroughly.

OPERATION OF TURCOFORM ETCHANT 9H Turcoform Etchant 9H solution is used at $190^{\circ} \pm 5^{\circ}\text{F.}$ for best results. The solution must be pre-heated to this temperature before introducing parts for etching. Etch rate at recommended concentration is approximately 1 mil/side/minute.

The amount of heat evolved in etching one pound of aluminum is approximately 7000 Btu, but additional heating is necessary for maintaining the proper tank temperature, since the etching of most production loads does not generate heat rapidly enough to offset the heat lost to the atmosphere.

All parts should be chemically clean to insure best results.

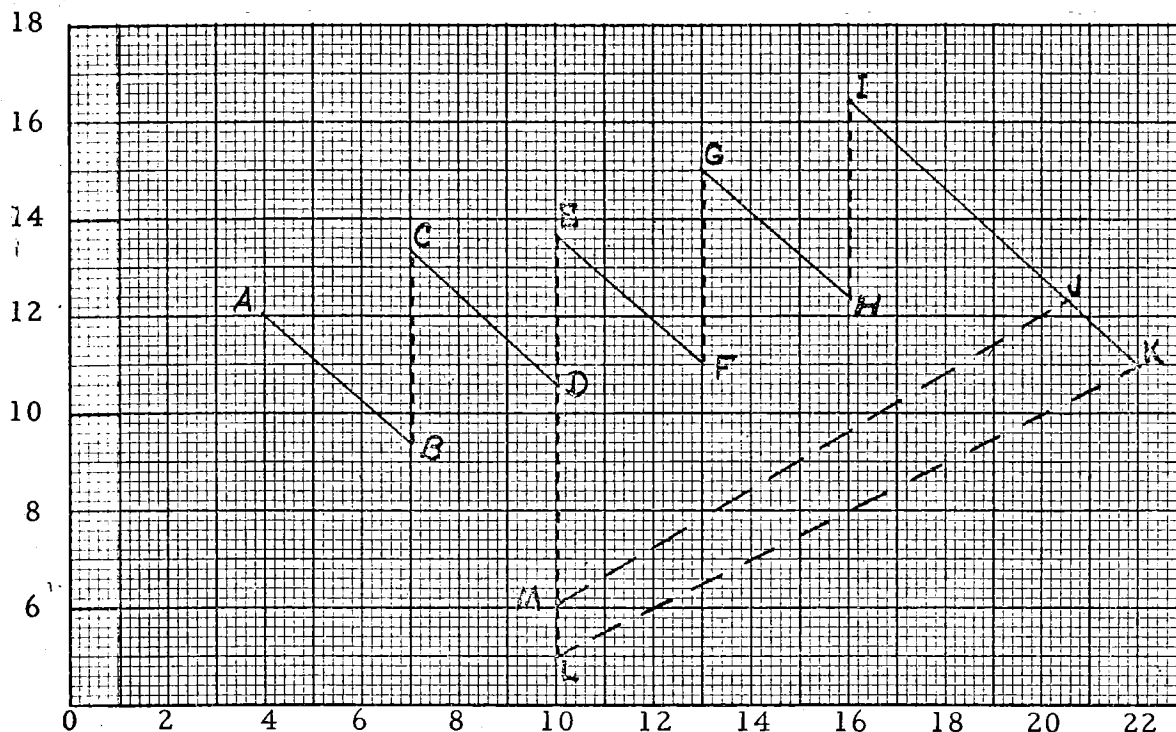
Suspend parts vertically or horizontally depending on part configuration. Rotate in the vertical plane every 30 minutes or as often as necessary to avoid tapering.

Agitate the solution during additions of 9H and while heating to temperature. Continuous agitation should be avoided since it has a deteriorative effect upon the etchant.

Immediately after etching, rinse parts in cold water and remove smut in Turco Smut-Go solution followed by a final water rinse.

A fresh bath will have an $N_1 = 12.0$ and $N_2 = 4.0$. To increase N_1 by 1 ml add approximately 0.08 lbs. of Turcoform Etchant 9H per gallon of etchant solution. To increase N_2 by 1 ml add approximately 0.15 lbs. of Turcoform Alketch Inhibitor per gallon of etchant solution. The use of Turcoform Alketch Inhibitor is an inexpensive way to add aluminum to the etchant solution, thereby increasing the N_2 value or "sweetening" the bath prior to etching. It need only be added to a fresh bath since the N_2 value increases as aluminum is dissolved in the etchant. To determine the amount of dissolved aluminum in pounds per gallon, multiply the N_2 value by 0.04. A portion (25-75%) of the etchant solution should be discarded when the N_2 value reaches the top of the recommended range. When the tank is dumped or recharged, do not clean or remove the black smut that forms on the tank walls.

N₁ in ml. of 1N H₂SO₄



N₂ in ml. of 1N H₂SO₄
FIGURE I

Example:

A fresh 1000 gallon bath has an N₁ of 12.0 and an N₂ of 4.0 (0.16 pounds per gallon of dissolved aluminum which comes from the Alketch Inhibitor). This corresponds to Point A in Figure I. Parts are then etched until 120 pounds of aluminum have been dissolved in this solution. The N₁ is now 9.4 and the N₂ is 7.0. This corresponds to Point B in Figure I. The bath is rejuvenated by adding 320 pounds of Turcoform Etchant 9H changing N₁ to 13.4 (The N₂ value remains essentially unchanged). The bath condition is represented by Point C. Points D through I are obtained by dissolving 120 pounds of aluminum each time and then adding 240, 320 and 320 pounds of Turcoform Etchant 9H.

When Point I is reached, parts are etched until the bath ceases to work efficiently. If 180 pounds of aluminum are dissolved, the bath condition will be represented by Point J. If 240 pounds of aluminum are dissolved, Point K will represent the bath condition. The bath may now be rejuvenated by dumping approximately 50% of the solution and making the tank up to operating level with water. This reduces the values of both N₁ and N₂ by half, bringing the solution to Point L (or M if the solution was dumped at Point J). By adding 600 pounds of Turcoform Etchant 9H, the N₁ value is raised to Point E and the etchant bath is ready for further use. Note that no Alketch Inhibitor is added after the initial charge. The cycle E to E is repeated indefinitely.

The above is a typical example of one way to control the etchant solution. The cycle E to E, can be relocated so that the etchant solution may be controlled in any desired operating area.

Neglecting the original charge of both Turcoform Etchant 9H and Alketch Inhibitor which are needed only once, the ratio of Turcoform Etchant 9H to dissolved aluminum will vary from 3.5 to 1 to 2.5 to 1 depending on the dump point on Line I-K in Figure I. The more aluminum dissolved on the final pass, the higher the etch bath efficiency.

CHEMICAL CONTROL Aluminum is dissolved during the etching operation causing a reduction in the strength of the etchant solution. To maintain concentration of chemicals at the proper level, it is necessary to make periodic additions of Turcoform Etchant 9H. No further additions of Turcoform Alketch Inhibitor are required after the initial charge.

The concentrations of two constituents of the solution, (a) N_1 , unused etchant and (b) N_2 , dissolved aluminum, should be determined each day or as often as experience dictates. Below are three methods of analysis. The analyst may use the test he prefers or finds most convenient.

METHOD FOR DETERMINATION OF ETCHANT AND DISSOLVED ALUMINUM

Test 1:

A. Reagents and Apparatus:

Copper Powder

Phenolphthalein Indicator (10 g Phenolphthalein/liter ethanol)

Indigo Indicator (5 g of 5, 5' - indigodisulfonic acid, disodium salt/liter of water. NOTE: When solution changes from blue to green on storing, discard and make fresh).

1N H_2SO_4

1 100 ml Erlenmeyer flask

1 5 ml pipet

1 25 ml buret

1 Sample Jar (approx. 50 ml.)

B. Sampling:

1. Obtain a sample from the well-mixed etchant bath. The sample may be taken directly by immersing and filling the sample jar suspended by a wire. Avoid contact of the etchant solution with the skin.
2. Stopper sample jar and allow solution to cool to $25^\circ \pm 3^\circ C$.
3. Add approximately 5 grams (1/2 tsp.) copper powder, stopper the jar and shake vigorously for one (1) minute.
4. Allow the solid to settle.

C. Titration:

1. From the clear, upper portion of the mixture in the sample jar, pipet a 5 ml sample into the 100 ml Erlenmeyer flask, add 25 ml. distilled water and six (6) drops of Indigo Indicator.
2. Titrate with 1N H_2SO_4 , until the color changes to blue. Record number of ml required as N_1 .
3. Add three (3) drops phenolphthalein indicator to the same solution in the Erlenmeyer flask and again titrate with 1N H_2SO_4 , until the color changes from purple to blue. Record the number of ml required as N_2 .
4. Using N_1 and N_2 and the attached Control Charts, find the intersection of the two values and adjust the etchant solution as indicated.

Test 2:

A. Reagents and Apparatus

1. Beckman Model pH-16 Pocket pH meter, or equivalent. Use a high glass electrode, accurate from pH 0 to 14.
2. Magne stir and Teflon-coated stirring rod.

3. 250 ml. Griffin Beaker.
4. 5 ml. pipet.
5. 25 or 50 ml. buret.
6. Sample jars (approx. 50 ml.)
7. 1 \underline{N} H_2SO_4
8. 10 pH Buffer Solution

B. Sampling

1. Obtain a sample from the well-mixed etchant bath.

C. Titration Procedure

1. Pipet a 5 ml. sample of the etchant into a 250 ml. beaker. Add the Teflon-coated Magnestir stirring rod and 120 ml of distilled water.
2. Standardize the pH meter with 10 pH buffer solution.
3. Rinse the electrode of the pH meter and place it in the beaker containing the sample.
4. Titrate with 1 \underline{N} H_2SO_4 until a pH of 11.3 is reached. Approach the end-point slowly and allow sufficient time for the pH meter to reach equilibrium.
5. Continue the titration with 1 \underline{N} H_2SO_4 until a pH of 8.2 is reached.
6. N_1 = Number ml. 1 \underline{N} H_2SO_4 to reach pH 11.3.
 N_2 = Number ml. 1 \underline{N} H_2SO_4 to go from pH 11.3 to 8.2.

Test 3:

A. Reagents and Apparatus

1. Filter paper (Whatman #2 or equivalent)
2. Glass funnel and holder
3. 250 ml. flask
4. 5 ml. pipet
5. 25 or 50 ml. buret
6. Phenolphthalein Indicator
7. 1 \underline{N} H_2SO_4

B. Sampling

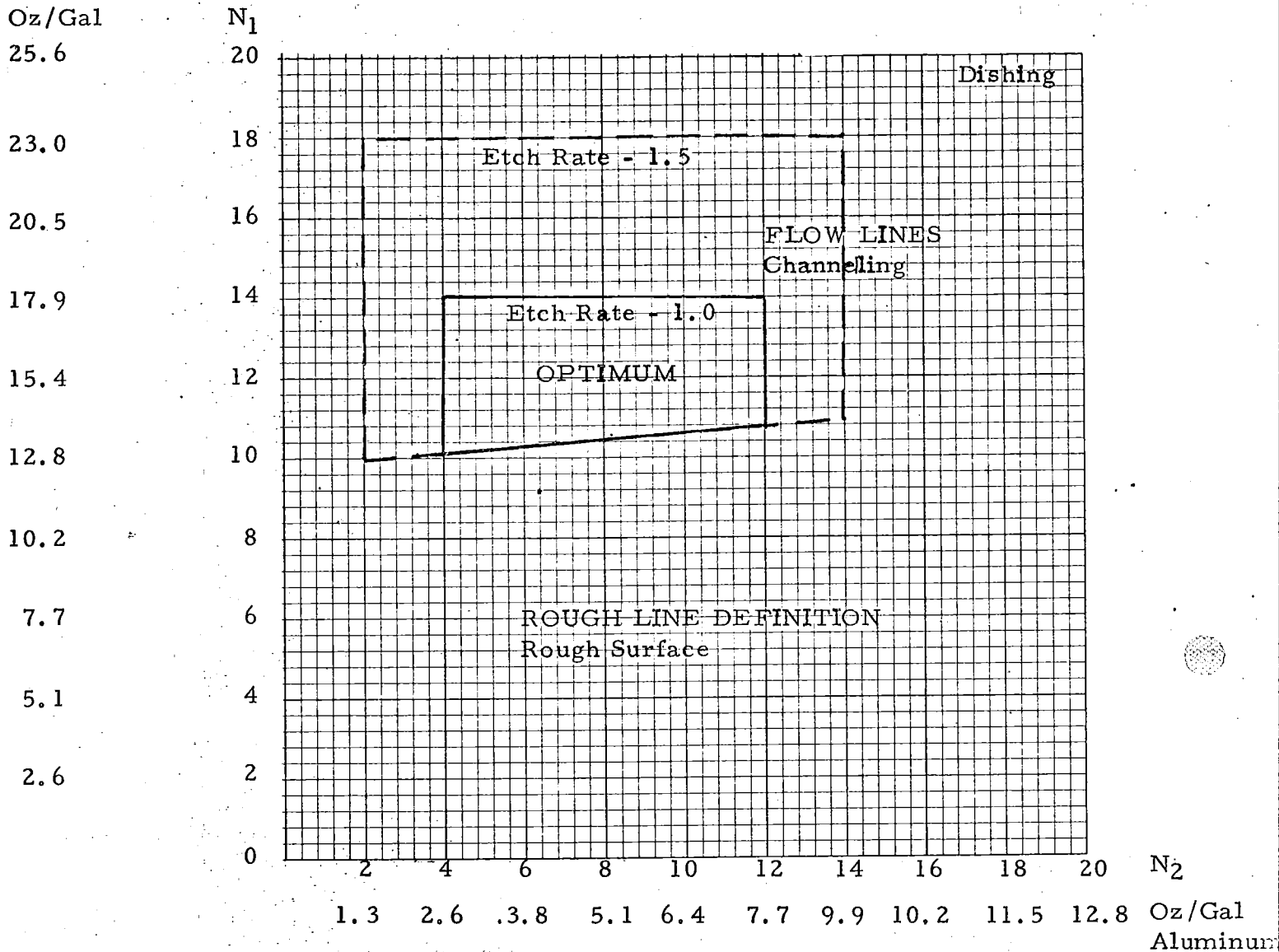
1. Obtain a sample from the well-mixed etchant bath.
2. Filter the sample or allow the smut to settle out.

C. Titration:

1. Pipet 5.0 ml. of the filtered or clear etchant sample into a 250 ml. flask. Add 120 ml. distilled water. The solution should be clear.
2. Titrate the above solution with 1.0 \underline{N} H_2SO_4 to the cloud point or until the solution becomes hazy. The number of mls. titrated is N_1 .
3. Add 2-3 drops of phenolphthalein indicator to the flask. The solution should turn reddish purple.
4. Continue to titrate until the reddish color disappears. The solution should appear milky white. The number of mls. titrated from the cloud point to the phenolphthalein end point is N_2 .

Recommended Operating Ranges for Turcoform Etchant 9H

7075-T6 7178-T6 Bare Alloys



N_1 = mls. of 1N H_2SO_4 to neutralize 5.0 mls. of etchant to pH 11.3

N_2 = mls. of 1N H_2SO_4 to continue neutralization to pH 8.2

CONTROL RANGE

N_1	10-18
N_2	2-14

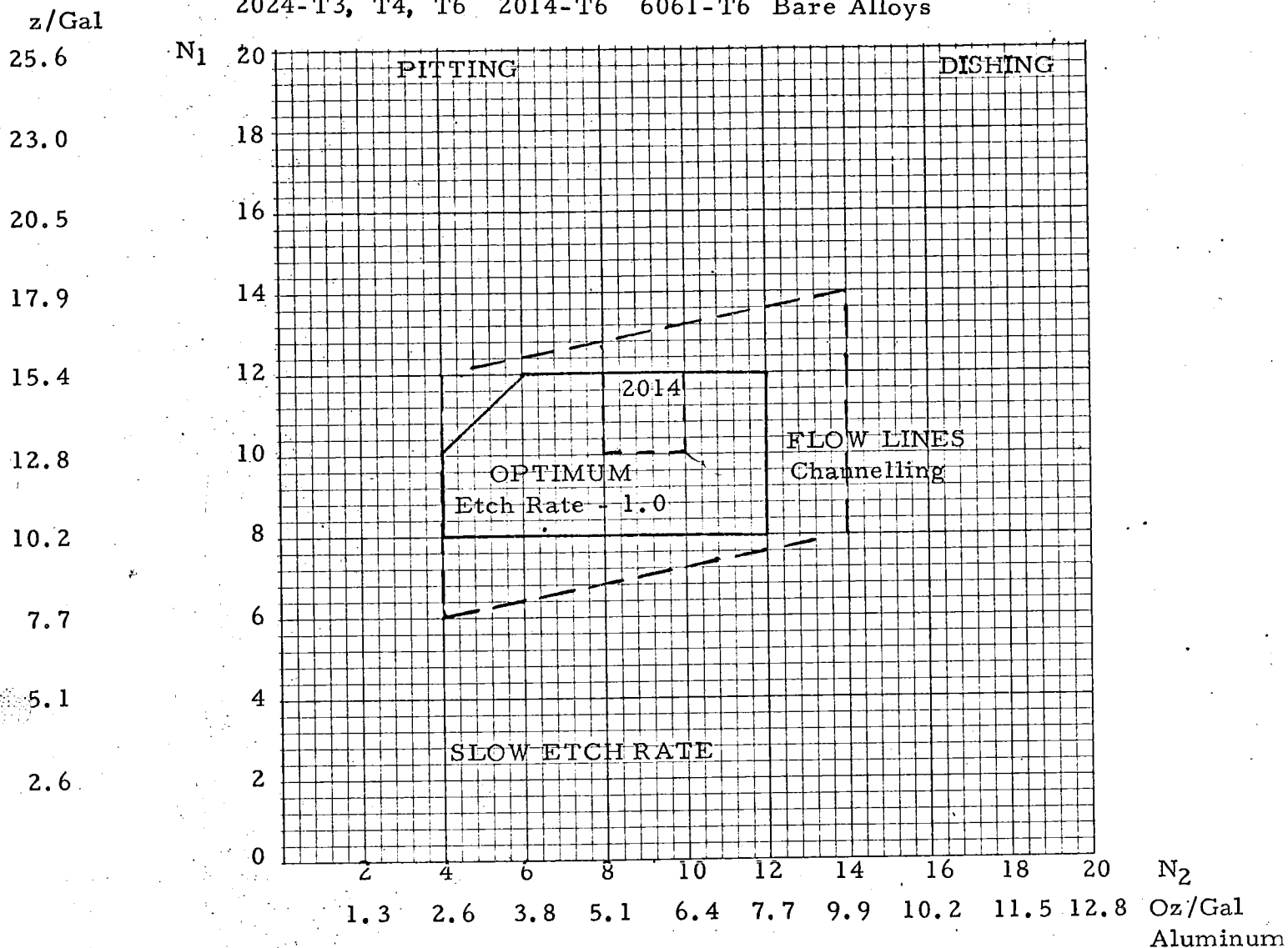
OPTIMUM

N_1	10-14
N_2	4-12

Parts may be etched in the total range, but channelling and flow lines may occur as the dissolved aluminum increases. At N_1 values above 14 close tolerance may be difficult to hold on deep cuts.

Recommended Operating Ranges for Turcoform Etchant 9H

2024-T3, T4, T6 2014-T6 6061-T6 Bare Alloys



N_1 = mls. of 1N H_2SO_4 to neutralize 5.0 mls. of etchant to pH 11.3

N_2 = mls. of 1N H_2SO_4 to continue neutralization to pH 8.2

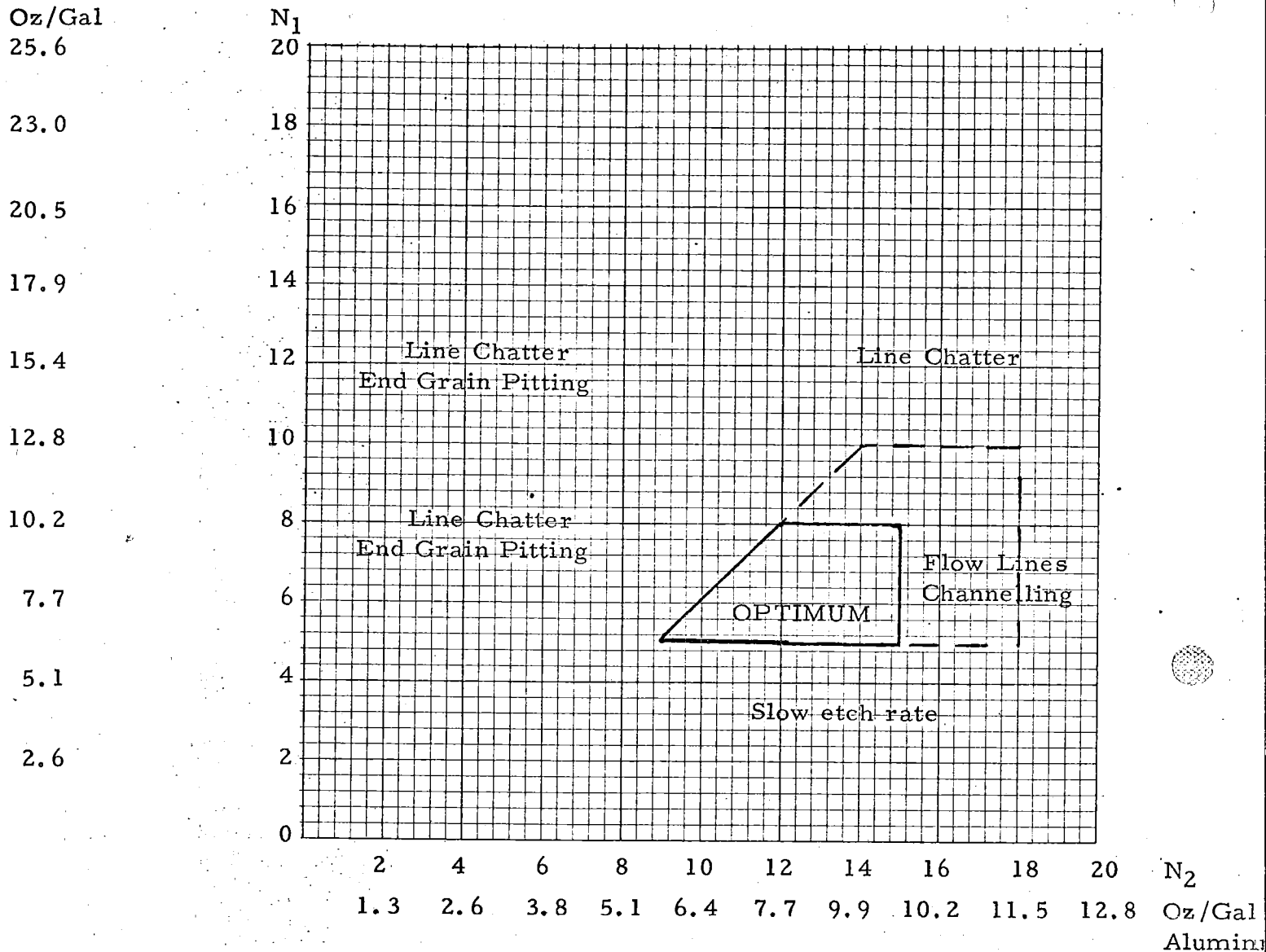
CONTROL RANGE

OPTIMUM

2024	N_1	6-14	8-12
	N_2	4-14	6-12
2014-T6	N_1	6-12	10-12
	N_2	4-14	8-10
6061-T6	N_1	6-12	6-10
	N_2	4-14	6-10

Recommended Operating Ranges for Turcoform Etchant 9H

Clad Alloys 6061-0 Bare Alloy



N₁ = mls. of 1N H₂SO₄ to neutralize 5.0 mls. of etchant to pH 11.3

N₂ = mls. of 1N H₂SO₄ to continue neutralization to pH 8.2

CONTROL RANGE

N ₁	5-10
N ₂	10-18

OPTIMUM

N ₁	5-8
N ₂	10-14

The above etching ranges should produce satisfactory line definition. If a 1:1 undercut is necessary, TFE 13B or 11 should be used.

PRODUCTION PROBLEMS ALUMINUM PROCESS

<u>PROBLEM</u>	<u>CAUSE</u>	<u>REMEDY</u>
Poor Line Definition	Dirty parts; finger prints; caustic or deoxidizer stains; incomplete removal of shop coats; incomplete removal of heat scale	Solvent wipe; Re-clean; Use ketone wipe; Re-deoxidize
	Mask lifted during scribing	Repair and re-scribe
	Incorrect etchant or etching range	Adjust etchant
	Parts left in de-smut excess time between step cuts	De-smut 1-2 minutes maximum or not until part is finished
Tapered Part	Improper rotation	Correct condition: Etch equal times in both directions
Rough Surface	Improper etchant range	Try raising N ₁ or N ₂
Channelling, flow lines, Ridging	Aluminum content (N ₂) too high Improper positioning or rotation	Dump part of tank and re-charge. Correct condition
Pitting	9H content (N ₁) too high Poor rinsing of solution after de-smutting	Dump part of tank and add water. Rinse thoroughly after de-smutting.
Dishing	N ₁ or N ₂ too high, or both	Adjust tank to recommended ranges.
Channel in Fillet of Clad Part	Scribed too hard	Scribe lightly or use hot knife.

	In general, as N ₁ increases:	as N ₂ increases:
Specific gravity of the bath	increases	increases
Viscosity of the bath	increases	increases
Etch Rate	increases	decreases
Etch factor (undercut:depth)	increases slightly	increases slightly
Surface smoothness	improves 7075, 7178T6	improves
End-grain pitting	can occur on Cu alloys such as 2024. Line chatter on clad increases	decreases Some clad alloys can be etched successfully. 6061 may be etched successfully. Foaming increases.

EQUIPMENT

Tank - C-1020 mild steel, no lining required. (NOTE: Protect exterior surface by using red lead primer and alkali resistant paint, such as Tygon or Amercoat.)

Tank Cover - A tank cover is recommended to prevent excessive heat loss during the night or periods of non-use.

Insulation - None required.

Agitation - Oil-free compressed air source required. Use mild steel pipe. (NOTE: Recommend agitation during etching cycle only. Continuous agitation should be minimized since it has a deteriorative effect upon the etchant).

Ventilation - Air-flow of 200-250 CFM per square foot of tank surface, with provisions for venting on four sides. A pull system should be used.

Air-duct construction - Use mild steel protected with alkali resistant paint.

Temperature instrumentation - Sufficient to control etchant solution to $190 \pm 3^\circ \text{F}$.

Heating Facilities - In general, steam will provide the most uniform heating and ease of control. However, electricity and gas have also proven satisfactory for heating these tanks. Final choice should depend upon facilities available and local conditions at each installation.

SHIPPING PACKAGE

Turcoform Etchant 9H is available in steel drums; net weight, 400 pounds.

The directions and recommendations given are intended to serve as a general guide to processors and may require modification, based on field experience, to meet local conditions.